Spectroscopy of ^{120}Sn Homologous Levels Via the ^{123}Sb($\vec{p}$, α)^{12O}Sn Reactions

P. Guazzoni[1], L.. Zetta[l], A. Covello[2], A. Gargano[2], Y. Eisermann[3], G. Graw[3], R. Hertenberger[3], H.-F. Wirth[3], M. Jaskola[4], B. Bayman[5], and W.E. Ormand[6]

[1] Dipartimento di Fisica dell'Universitii and LN.F.N, I-20133 Milano, Italy; [2] Dipartimento di Fisira dell'Universit4 and LN.F.N, 1-80126 Napoli, Italy; [3] Sektion Physik der Universitiit Miinchen, D-85748 Garching, Germany; [4] Soltan Institute for Nuclear Studies, Warsaw, Poland; [5] Physics and Astronomy Department, University of Minnesota, Minneapolis; [6] Lawrence Livermore National Laboratory, CA-94551 Liveffnore, USA

In order to investigate the spectator role of the $1g_{7/2}$ unpaired proton outside the Z=50 closed shell in the ^{123}Sb nucleus and to test in this region the validity of the concept of homology, which we already tested in the Z=40 and Z=82 regions [1-4], the reaction ^{122}Sn ($\vec{p}$, α)^{119} was measured [5] and the reaction ^{123}Sb($\vec{p}$, α)^{12O}Sn is currently studied. The high resolution experiment was carried out with the 24 MeV proton beam of the Munich MP Tandem accelerator, using the Stern-Gerlach source for intense and bright beams of negative polarized Hydrogen ions 16], the Q3D magnetic spectrograph and the new light ion focal plane detector with cathode- strip readout [7]. High resolution and very low background allowed study of 53 transitions to final states of ^{120}Sn up to an excitation energy of ~4500 keV.

In ($\vec{p}$, α) reactions use of polarized protons allows the measurement of asymmetry angular distributions, which is an essential tool, in addition to the cross section angular distributions, to unambigously identify spin and parity of the ex6ted levels. In the energy spectra from *(p,a)* reactions on odd near magic nuclei, two different contributions can be observed. At low excitation energy some weakly excited states are populated by the pickup of the spectator proton plus a neutron pair. At higher excitation energies multiplets of states are populated, whose configurations result from the coupling of the spectator proton with the one-proton-hole-two-neutron-hole excited states in the core ^{119}In. These multiplets of states are homologous of the low energy states of ^{119}In excited in the corresponding ($\vec{p}$, α) reaction on ^{122}Su.

The homology between the low lying states of ^{119}In and the higher energy states of ^{12O}Sn allows one to attribute spin and parity to these latter states. In fact, if the coupling is weak, the relative cross sections for the population of a homologous state with spin J_i in a given multiplet must be proportional to $2J_i + 1$. This expectation is very well fulfilled by the octect of states homologous to the ground state of ^{119}In.

In connection with the experimental work, theoretical calculations are in progress in order to microscopically describe the transitions to "'In low-lying states and to search for states in ^{120}Sn whose wave functions may resemble the wave function of a low-lying state in "'In coupled to a spectator $_{g7/2}$ Proton.

This work was performed in part under the auspices of the Italian Ministry for University and Reseamh, under contract CRUI-Progetto Vigoni, the DFG under Grant No. C4-Gr89412, and the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under continet No. W-7405-Eng-48.

[1] P. Guazzoni et al., Z. Phys. A 356, 381 (1997).
[2] P. Guazzoni et al., Eur. Phys. J. Al, 365 (1998).
[3] P. Guazzoni et al., Phys. Rev. C 49, 2784 (1994).
[4] J. N. Gu et al., Phys. Wv. C 55, 2395 (1997).
[5] P. Guazzoni et al., AIP 570, p.664, 2001.
[6] R. Hertenherger et al., AIP 570, p.825, 2001.
[7] H.-F. Wirth, Ph.D. thesis, TU Miinchen, 2001.